

REMARKS

Claims 32 and 41 are currently amended. Applicant respectfully submits that the amendments contained herein are fully supported by the Specification as originally filed and do not include new matter.

Claim Rejections Under 35 U.S.C. § 102

Claims 1-7, 11-17, and 32-36 were rejected under 35 U.S.C. § 102(b) as being anticipated by Rathore et al. (U.S. Patent No. 6,258,710). Applicant respectfully traverses.

Claim 1 recites a first metal layer on a diffusion barrier layer, wherein the first metal layer comprises a first metal component and a second metal component forming a crystalline compound with the first metal component. This is different from Rathore et al. The Examiner has taken layer 5 (Figure 3, column 8, lines 1-3) of an adhesive and contact metal as corresponding to the diffusion barrier layer of claim 1. The Examiner has combined layer 6 of a material, such as chromium--chromium oxide, tungsten-silicon, tungsten-nitride, tungsten-nitride-silicon, titanium-nitride, tantalum or tantalum-nitride, with layer 7 of an element that is capable of forming an intermetallic compound with copper (Figure 3, column 8, lines 5-35), and has taken combined layer 6/7 to correspond to first metal layer of claim 1. The Examiner has apparently taken layer 7 as corresponding to the first metal component of the metal layer of claim 1, and has taken layer 8 (Figure 3, column 8, lines 37-38), a copper seed layer, as corresponding to the second metal component of the metal layer of claim 1. However, there is no indication in Rathore et al. of layer 7 and 8 actually forming a crystalline compound. Instead, column 8, lines 32-35, indicate that layer 7 is capable of forming an intermetallic compound with copper, which is not the same as actually forming a crystalline compound, as recited in claim 1. Therefore, Rathore et al. does not include each and every recitation of claim 1, and claim 1 should be allowed.

Claims 2-6 depend from claim 1 and thus are allowable for at least the same reason as claim 1. Therefore, claims 2-6 should be allowed.

Claim 7 recites a first metal layer on a layer of titanium nitride, wherein the first metal layer includes a crystalline alloy compound containing a first metal component and a second metal component. This is different from Rathore et al. Rathore et al. has a layer 5 that can be a

combination of titanium and a nitride (column 8, lines 1-5). Rathore et al. includes a layer 6 on layer 5 (Figure 3) and a layer 7 on layer 6. Layer 6 is of a material, such as chromium--chromium oxide, tungsten-silicon, tungsten-nitride, tungsten-nitride-silicon, titanium-nitride, tantalum or tantalum-nitride. Layer 7 is capable of forming an intermetallic compound with copper and is of an element that may be selected from the group consisting of hafnium, lanthanum, zirconium, tin and titanium (column 8, lines 35-37). A copper seed layer 8 is on layer 7 and a copper layer 9 is on layer 8. Layer 6 does not include a crystalline alloy compound containing a first metal component and a second metal component, as recited in claim 7, nor does layer 6 in combination with layer 7 nor layers 6, 7, and 8 in combination. Therefore, Rathore et al. does not include each and every recitation of claim 7, and claim 7 should be allowed.

Claims 11-13 depend from claim 7 and thus are allowable for at least the same reason as claim 7. Therefore, claims 11-13 should be allowed.

Claim 14 recites a first metal layer on a titanium nitride layer, wherein the first metal layer comprises copper and a metal component forming a crystalline compound with the copper, wherein the metal component is selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium. This is different than Rathore et al. As indicated in conjunction with claim 7 above, Rathore et al. has a layer 7 capable of forming an intermetallic compound with copper that is of an element that may be selected from the group consisting of hafnium, lanthanum, zirconium, tin and titanium (column 8, lines 35-37). A copper seed layer 8 is on layer 7 and a copper layer 9 is on layer 8. However, there is no indication in Rathore et al. of layer 7 or any other layer actually forming a crystalline compound with copper layer 8 or copper layer 9. Therefore, Rathore et al. does not include each and every recitation of claim 14, and claim 14 should be allowed.

Claim 15 recites a metal layer on a layer of titanium nitride, wherein the metal layer has a copper-rich alloy selected from the group consisting of Cu_4Sc , Cu_6Y , Cu_4Ti , Cu_3Ti and Cu_5Zr ; and a copper layer on the metal layer. This is different than Rathore et al. As indicated in conjunction with claim 7 above, Rathore et al. has a layer 7 capable of forming an intermetallic compound with copper that is of an element that may be selected from the group consisting of hafnium, lanthanum, zirconium, tin and titanium (column 8, lines 35-37). A copper seed layer 8 is on layer 7 and a copper layer 9 is on layer 8. However, there is no indication in Rathore et al.

of layer 7 or layers 6 and 7 alone or in combination having a copper-rich alloy selected from the group consisting of Cu₄Sc, Cu₆Y, Cu₄Ti, Cu₃Ti and Cu₅Zr. Therefore, Rathore et al. does not include each and every recitation of claim 15, and claim 15 should be allowed.

Claims 16-17 depend from claim 15 and thus are allowable for at least the same reason as claim 15. Therefore, claims 16-17 should be allowed.

Claim 32, as currently amended, recites a layer of a metal alloy nitride on a diffusion barrier layer, wherein the layer of metal alloy nitride comprises a first metal component, a second metal component that can form a crystalline compound with the first metal component, and nitrogen. This is different than Rathore et al. Based on the discussions above in conjunction with claim 7, layer 6 does not include a layer of a metal alloy nitride that comprises a first metal component, a second metal component that can form a crystalline compound with the first metal component, and nitrogen, as recited in claim 32, nor does layer 6 in combination with layer 7 nor layers 6, 7, and 8 in combination. Therefore, Rathore et al. does not include each and every recitation of claim 32, and claim 32 should be allowed.

Claims 33-36 depend from claim 32 and thus are allowable for at least the same reason as claim 32. Therefore, claims 33-36 should be allowed.

Claim Rejections Under 35 U.S.C. § 103

Claims 8-10, 18-22 and 37-48 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Rathore et al. Applicant respectfully traverses.

Claims 7 and 15 are patentably distinct from Rathore et al. Claims 8-10 depend from claim 7 and thus are allowable for at least the same reason as claim 7. Claims 18-20 depend from claim 15 and thus are allowable for at least the same reason as claim 15. Therefore, claims 8-10 and claims 18-20 should be allowed.

Claims 21 and 22 each recite a first metal layer on a layer of titanium nitride, wherein the first metal layer comprises elemental copper, wherein the first metal layer further comprises a copper-rich crystalline alloy compound containing copper and a metal component selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium. This is different than Rathore et al. As indicated in conjunction with claim 7 above, Rathore et al. has a layer 7 capable of forming an intermetallic compound with copper that is of an element that may

be selected from the group consisting of hafnium, lanthanum, zirconium, tin and titanium (column 8, lines 35-37). A copper seed layer 8 is on layer 7 and a copper layer 9 is on layer 8. However, there is no indication in Rathore et al. of layer 7, 8, or 9 or any other layer that comprises elemental copper and a copper-rich crystalline alloy compound containing copper and a metal component selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium. Therefore, Rathore et al. does not include each and every recitation of claim 21 or 22. Therefore, claims 21 and 22 are patentably distinct from Rathore et al. without relying on a specific amount of copper (Claim 21) or a specific copper to metal component ratio (Claim 22) and are thus not obvious. Therefore, claims 21 and 22 should be allowed.

Claim 37 recites a nitride metal alloy compound containing a first metal component, a second metal component and nitrogen. This is different than Rathore et al. Based on the discussions above in conjunction with claims 1 and 7, neither of layers 5, 6, 7, or 8 alone or in various combinations is a nitride metal alloy compound containing a first metal component, a second metal component and nitrogen, as in claim 37. Therefore, claim 37 is patentably distinct from Rathore et al. without relying on a specific atomic ratio of the first metal component to the second metal component and is thus not obvious. Therefore, claim 37 should be allowed.

Claims 38-40 depend from claim 37 and thus are allowable for at least the same reason as claim 37. Therefore, claims 38-40 should be allowed.

Claim 41, as currently amended, recites a layer of a metal alloy nitride on a titanium nitride layer, wherein the layer of metal alloy nitride comprises copper, a metal component that can form a crystalline compound with the copper, and nitrogen. This is different than Rathore et al. Based on the discussions above in conjunction with claims 1 and 7, neither of layers 5, 6, 7, or 8 or various combinations thereof is a layer of a metal alloy nitride, where the metal alloy nitride comprises copper, a second metal component that can form a crystalline compound with the first metal component, and nitrogen, as in claim 41. Therefore, claim 41 is patentably distinct from Rathore et al. without relying on a specific atomic ratio of copper to the metal component in the-layer of metal alloy nitride and is thus not obvious. Therefore, claim 41 should be allowed.

Claim 42 depends from claim 41 and thus is allowable for at least the same reason as claim 41. Therefore, claim 42 should be allowed.

Claims 43 and 46 each recite a nitrided metal layer on a layer of titanium nitride, wherein the nitrided metal layer is of the form MT_xN_y , where M is a first metal component, T is a Group IIIA or Group IVA transition metal, N is nitrogen, x is an atomic fraction of T, y is an atomic fraction of N. This means that the nitrided metal layer is a compound that includes a first metal component M, a transition metal T, and nitrogen. This is different than Rathore et al. Based on the discussions above in conjunction with claims 1 and 7, neither of layers 5, 6, 7, or 8 or various combinations thereof is a nitrided metal layer that is a compound that includes a first metal component M, a transition metal T, and nitrogen, as in claim 43 or 46. Therefore, claims 43 and 46 are patentably distinct from Rathore et al. without relying on specific values of x and y and is thus not obvious. Therefore, claims 43 and 46 should be allowed.

Claims 44-45 depend from claim 43 and thus are allowable for at least the same reason as claim 43. Therefore, claims 44-45 should be allowed.

Claim 47 recites a nitrided metal layer on a layer of titanium nitride, wherein the nitrided metal layer is of the form CuT_xN_y , where Cu is copper, T is a Group IIIA or Group IVA transition metal, N is nitrogen, x is an atomic fraction of T, y is an atomic fraction of N. This means that the nitrided metal layer is a compound that includes a copper, a transition metal T, and nitrogen. This is different than Rathore et al. Based on the discussions above in conjunction with claims 1 and 7, neither of layers 5, 6, 7, or 8 or various combinations thereof is a nitrided metal layer that is a compound that includes copper, a transition metal T, and nitrogen, as in claim 47. Therefore, claim 47 is patentably distinct from Rathore et al. without relying on specific values of x and y and is thus not obvious. Therefore, claim 47 should be allowed.

Claim 48 depends from claim 47 and thus is allowable for at least the same reason as claim 47. Therefore, claim 48 should be allowed.

Allowable Subject Matter


Applicant acknowledges that claims 23-31 and 49-54 were allowed.

CONCLUSION

In view of the above remarks, Applicant believes that the claims are in condition for allowance and respectfully requests a Notice of Allowance be issued in this case. If the Examiner has any questions regarding this application, please contact the undersigned at (612) 312-2208.

Respectfully submitted,

Date: 07-28-05



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